

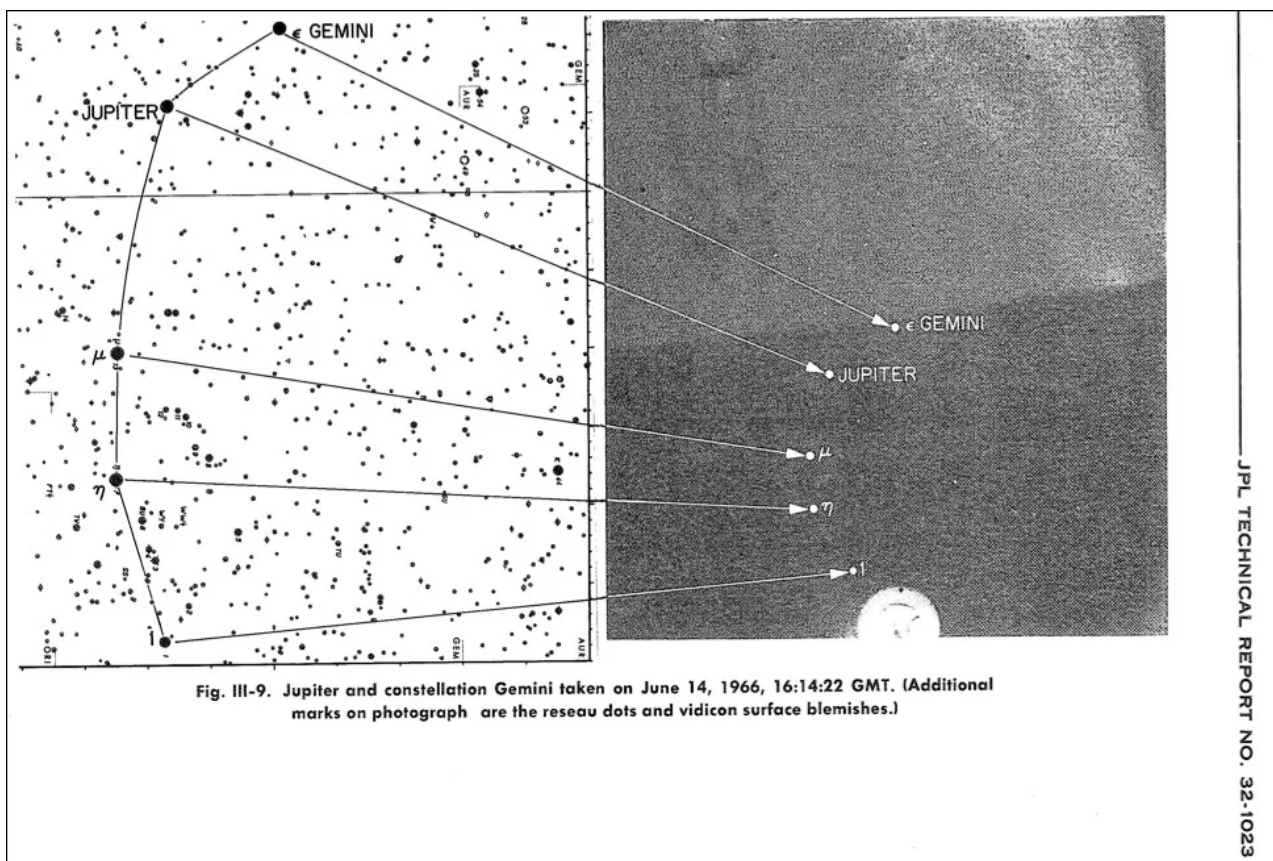
26. Настоящая причина, почему на лунных снимках не видно звёзд.

9-11 minutes

Take your time to say that you have already read articles on this topic, and therefore you know in advance what I will write.

I'm not going to write about what you have heard many times - that the lunar soil is too bright and the stars are too dim to be photographed from the lunar surface. I will write about something else - that the stars can be photographed. And I will even post one of these pictures - a view of the starry sky from the surface of the Moon.

The picture, however, is not very high quality, since it is a scan from a book. More precisely, a scan from a technical report. The picture was taken in 1966 by the Surveyor automatic station. The picture shows the stars of the constellation Gemini and the nearby Jupiter.



A snapshot of the starry sky (in the right half) taken from the surface of the Moon in 1966.

The starry sky from the Moon is photographed in the same way as on Earth - by increasing the shutter speed. At a short shutter speed, the stars will not be exposed, and at a shutter speed of 1-2 seconds, bright stars will be seen very well. In order for Jupiter to become visible against the background of a black sky, generally 1/30 sec is enough. We are talking about the sensitivity of 160 ASA film, which was at the disposal of NASA in 1969.

Exploration of the Moon by automatic interplanetary stations began in 1959, 10 years before the so-called "moon landing". For the first time the interplanetary automatic station "Luna-2" reached the surface of the Moon, delivering a pennant with the image of the coat of arms of the USSR to the Moon. Then "Luna-3" in October 1959 photographed the far side of the moon, and "Luna-9" in February 1966 made a soft landing on the lunar surface and transmitted to Earth the first lunar panoramas in the landing area.

The United States lagged behind the Soviet Union, but in the summer of 1966 they also managed to make a soft landing. The automatic station "Surveyor-1" has transmitted the first images from the lunar surface. There was also a picture of the starry sky, which was taken in the last quarter of the moon, when sunlight was leaving the surface.

There is no question - is it possible to photograph stars from the lunar surface? The answer is clear - on a moonlit night, of course, you can. Is it possible to photograph the starry sky on a lunar day when the surface is brightly illuminated by the sun?

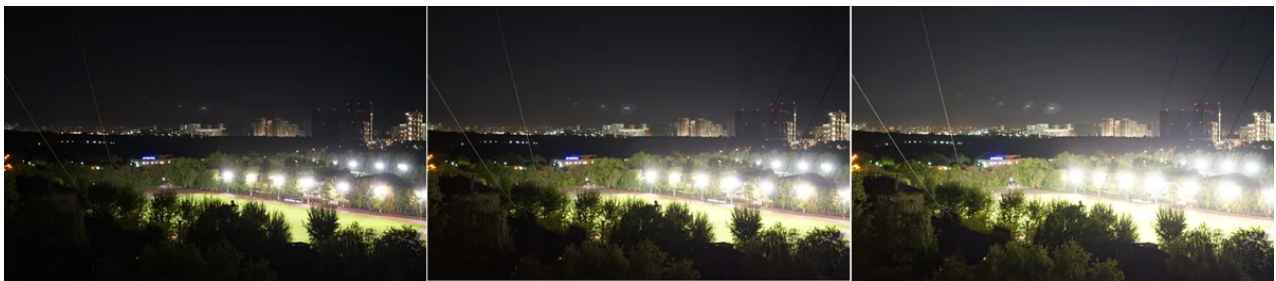
To answer this question, we conducted an experiment at night within the city limits - we photographed the starry sky and brightly lit objects at different exposures. The top of the frame was filled with a night sky with stars, and the bottom of the frame was a brightly lit stadium.

The football field was illuminated by floodlights mounted on 14 poles: 7 poles on one side of the field and 7 poles on the other side. Four searchlights were attached to each pole. In total, the football field was lit by 56 floodlights. In addition, there were street lighting poles and other searchlights nearby.



The football field is illuminated by 56 floodlights.

We took some pictures with slower shutter speeds. Naturally, at the same time, the football field began to lighten.



Sequential increase in shutter speed.



With long exposures, the stadium whitens, and stars appear in the sky.

When the shutter speed was over 1 second, stars began to appear in the pictures. The difficulty in detecting stars in the image occurred for the following reason. The air within the city limits, especially near the horizon, strongly scattered the light; instead of black, the sky became gray with increasing exposure. And for the star to be seen, it must be brighter than the gray background.



The stadium is heavily overexposed, but the stars are visible in the sky.

So that the stars could be better seen, we made a frame for you, and then darkened the selected fragment in a graphic editor.



Fragment of the previous frame.



A fragment of the frame is darkened in the graphics editor.

So, is it possible to photograph the starry sky on the moon during the day if there are very bright objects in the frame? Yes it is possible. With a slow shutter speed, the stars will be worked through, but light objects will become whitened.

The question immediately arises: will it not turn out that the scattering of light in the lens due to bright details will whiten the entire frame, and we will not distinguish the stars? We saw that in our experiment with a long exposure, the sky turned out to be covered with a light haze.

However, the sky is covered with haze not due to the scattering of light in the lens, but due to the fact that in terrestrial conditions there is dust in the atmosphere (especially near the horizon), and it strongly scatters light. In addition, light is scattered due to fluctuations in air molecules. Even far from the city, the sky near the horizon is lighter than dim objects such as trees. There is some light in the trees, as you can see in the next photo, but even these slightly lit trees appear as a black silhouette against the night sky.



Starry sky outside the city, the Milky Way. Photo by Yuri Kozlov (Kandalaksha).

And in the moonlit sky, there is no scattering of light. If you photograph the starry sky from the Moon, then with increasing shutter speed, the sky was black, so it will remain black.

Even in our photo, notice that as the shutter speed increases, the sky turns gray instead of black, but the roofs of the houses in the foreground (at the bottom of the frame) are still black. And in the middle of the image, the dark strip of the city is blacker than the nearby sky.



The sky becomes lighter than dark rooftops due to the scattering of light in the atmosphere.

However, I already foresee the objection that scattering in optics will be very strong - from those who were an amateur photographer in childhood and shot with cheap cameras with plastic lenses. Of course, cheap lenses scatter light inside the lenses a lot. Lenses made before 1920 scattered light a lot. But then it was invented [lens](#) coating - reduction of parasitic reflections from lens surfaces by applying a very thin interference coating in one or several layers. Modern lenses have multi-layer coating (**MC** - Multi Coating), they are easy to identify by the colored reflections of bright objects in the lenses, which change their color due to light interference when the lens is tilted - from purple-violet to green-yellow shades.



Multi Coating Lens

Even the sun directly hitting the frame does not light up the frame, this is clearly seen in the images from the ISS. Light scattering in the lens is minimized.



A snapshot of the Sun in space from the ISS.

So, we come to the conclusion that there is no technical difficulty in photographing the starry sky from the surface of the Moon, and there never was. If we look at the Hasselblad lens, we see three rings.



"Lunar" Hasselblad.

The first ring is to set the shutter speed, the second ring is to set the aperture and the third ring closest to the camera body is to focus the lens, set the shooting distance.



Three rings on the lens (top to bottom): 1 - shutter speed, 2 - aperture, 3 - focusing distance.

You can see that the camera provides a wide range of shutter speeds - from very short, 1/500 s (indicated by "500"), to very long: 1/2 second (indicated by "2"), 1 second (indicated by "1") and even more. The letter "B" stands for "hand exposure" - the shutter will open while the finger presses on the shutter release button.

You can, of course, be ironic and write that the astronauts did not master the camera well and did not know that the shutter speed ring can be turned counterclockwise to the end and set the shutter speed to 1 sec or more. And if someone told them about this, then they would certainly have photographed the starry sky, because even 1 second is enough for bright stars to expose the film.

What is so difficult here? Stand in the shadow of the lunar module (the sun does not shine into the lens), set one astronaut in silhouette against the sky, set the exposure for 1 sec and photograph the starry sky behind him. It could have been a gorgeous, spectacular shot: the astronaut in the foreground and the abyss of stars behind him. But there are no such pictures, because no one has landed on the moon. And the atmosphere interferes with obtaining a starry sky "like on the Moon" in terrestrial conditions. Therefore, NASA does not have such images.

Continuing to be ironic, we can write that especially for lunar expeditions, the shutter speed ring on the lens was made non-rotating, fixing it at a single shutter speed of 1/250 s, so that there was no temptation to photograph the starry sky.

There is no technical difficulty in photographing the starry sky from the moon during the day. On the camera, you just need to set a shutter speed of 1 sec (or more, which the camera allows) and stand in the shade for filming. But NASA has no stars in the lunar sky, since the filming was carried out not on the moon, but in the pavilion. Well, where in the pavilion can the stars come from on a black velvet backdrop?

*

Cameraman L. Konovalov was with you

Thanks for attention! Any comments would be welcome!



Until next time!